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**An Analysis of Potential Treasury Auction Techniques**

Reinhart, Vincent

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**ABSTRACT:** Academic literature suggests that the current Treasury procedure has drawbacks, but it does not readily identify the best way to auction government securities. While the Treasury may not always get top dollar for its issues, the present auction system may ease the conduct of monetary policy and ensure a deep and active secondary market in government obligations. The shift to single-price awards may mark an improvement over the current technique, but it may not avoid the repetition of recent experience. No matter how rigidly rules are enforced, the incentive to manipulate the market remains. A transition to a new auction system has potential problems, as any reform is likely to be designed to entice investors to bid directly. Investors may be hesitant to step in, preferring to observe before acting, especially if bidding has a substantial fixed cost. However, if access to the auction were kept open, scores of price-sensitive investors in the Treasury market might step in should auction prices differ markedly from those in secondary trading.

**TEXT:** Last summer's revelation of abuses of the rules governing the primary market for government securities spurred a comprehensive review of all aspects of market activity. Some of that work appeared in the Joint Report on the Government Securities Market, which the U.S. Department of the Treasury, the U.S. Securities and Exchange Commission, and the Board of Governors of the Federal Reserve System transmitted to the Congress in January 1992. While the Joint Report addressed many issues, its advocacy of experimentation with alternative auction designs for selling Treasury securities in particular attracted considerable attention. This attention likely owed to the sizable stakes. With the outstanding federal debt totaling \$2.8 trillion and mounting with each year's fiscal deficit, the gain to the Treasury from even a modest improvement in selling technique could be substantial. In fiscal year 1991, for example, gross issuance by the federal government exceeded \$1.7 trillion. Given that scale of borrowing, a reduction of one basis point in the average annual issuing rate at Treasury auctions would trim more than \$200 million from the federal deficit each year. At the same time, the Treasury must maintain the integrity of the auction process by ensuring that no illicit activity is hidden by the sheer volume of transactions. A concern by investors that the market was not open and fair would be translated into lessened demands for Treasury debt and higher costs of borrowing.

By reviewing the academic literature on auctions, this article puts current Treasury practice and a popular proposal for reform in critical perspective. It also examines the alternative scheme embraced in the Joint Report that uses technology to give better protection against certain kinds of manipulative behavior and that has a potential for lowering borrowing costs.

**BACKGROUND ON BIDDING**

There is a large academic literature on auctions, with important early contributions by William Vickrey and Milton Friedman and significant later

work by Paul Milgrom, among others (see the references at the end of the article). This research has classified the types of auctions, rigorously modeled the bidding strategies, and ranked auctions by various criteria regarding efficiency. Unfortunately, this literature has a language all its own that differs from the terms that the financial press uses. To avoid confusion, this article will use explicit, if somewhat unwieldy, names for each auction.

William Vickrey established the basic taxonomy of auctions by classifying them based on the order in which prices are quoted and the way in which bids are entered. (1) First, securities can be awarded at prices that are progressively lowered until the entire issue is sold; alternatively, the auctioneer can arrange the bids in ascending order by their price and decide on a single price that places the total issue. By the second measure, the auction can be a private affair with sealed bids opened by the auctioneer, or it can be conducted in real time, with participants in a single room or connected by phone bidding in public. This two-by-two classification yields four auction types: the first-price sealed-bid auction, the second-price sealed-bid auction, the descending-price open-outcry auction, and the ascending-price open-outcry auction.

Complicating matters, researchers after Vickrey further classified models by an assumption about the information that bidders have regarding the value of the auctioned object. One such model is the private-values case, in which bidders' valuations are subjective decisions, independent of each other. Another is the common-values case, in which each participant attempts to measure the value of the item by the same objective yardstick. The auction of a unique work of art not for resale is the prototypical private-values model, whereas a Treasury auction--with each bidder guessing at the security's value at the end of the day--is an example of a common-values model. This article concentrates on the common-values case, which is applicable to the sale of Treasury securities, and also assumes that agents care only about maximizing profit.

In general terms, the expected profit from winning an auction for bidder  $i$ ,  $\pi_i$ , depends on the expected value of the security in secondary market trading,  $v_i$ , less the awarded price,  $b_i$ , times the probability of winning the auction,  $Pr_i$ . In more formal terms and using  $i$  as an index to represent the bidders in the auction,

$$\pi_i = (v_i - b_i) * Pr(b_i > b_j, \text{ for all other } j).$$

The format of the auction determines how the bid price affects the probability of winning and the profit from acquiring the security, as well as what information is revealed about the security's value through the auction process.

#### FIRST-PRICE SEALED-BID AUCTION

The current practice of auctioning government securities falls into the first-price sealed-bid category, which in the financial community is termed an English auction (except by the English, who call it an American auction). Bidding takes place in private and, as diagram 1 shows, awards are made at the highest priced bids covering the total auction size. (Diagram 1 omitted) It is termed a first-price auction because in the sale of one unit of good or security the award is made at the highest bid. In the figure, the horizontal bars measure the cumulative amount of bids at the given price or higher. (2) Thus, participants pay differing prices reflecting the strength of their bids.

In terms of the expected return from winning the auction, a high bid lowers the profit from victory and raises the probability of winning. The strategic bidder trades between the two: He or she lowers the bid relative to valuation in order to profit more from winning and accepts the risk of lowering the probability of winning. The optimal strategy is to shade a bid toward the perceived market consensus; the more certain that consensus is

(in terms of lower variability), the more the strategic investor will shade his or her bid.(3)

Another factor comes into play in the common-values case: Since all participants guess about the price--where the security will trade after the auction--a high bid signals a heightened probability of subsequent loss of profit for that bidder. In that sense, winning is losing, as entering the highest bid signals that one's valuation exceeds that of all other interested parties. This is the "winner's curse" and gives aggressive bidders an additional reason to rein in their enthusiasm. Avoiding the winner's curse may lead to the pooling of bids, as a group of investors is more likely to have a clearer view of the market consensus and is less likely to be in the far end of the bid-price distribution. The pooling of bids is a service provided by dealers, who collect customer business and place large-scale orders.

#### SECOND-PRICE SEALED-BID AUCTION

The Treasury could collect sealed bids, arrange them by price, and award all the securities at a single price that just places the entire issue (diagram 2). (Diagram 2 omitted) This auction is termed second-price because, when a single unit is on the block, the price charged would be that of the highest bid below the price that places the issue, or the second-best price. The second-price auction, called a Dutch auction in the financial press, has been proposed as a simple alternative to current Treasury practice that would prevent the type of abuses witnessed last year while lowering average borrowing costs.(4)

A second-price auction, in which the winner pays, not his or her bid, but only the second-best bid, severs the gain in winning from the probability of winning. An aggressive bidder can receive a sure award but pay a price closer to the market consensus. As a result, less of the shading that marks the response to the winner's curse should occur. Accordingly, customers may be more willing to place their business directly by bidding at the auction than to go through a dealer.

#### DESCENDING-PRICE OPEN-OUTCRY AUCTION

This procedure is used to auction flowers in the Netherlands, hence it is referred to by academics as a Dutch auction. Bidders congregate in one room, or plug into its electronic equivalent, and wait as the auctioneer calls out a sequence of decreasing prices. In an auction of one unit of a good or security (diagram 3), the auction stops when one bidder is willing to pay the price called out. (Diagram 3 omitted) For multiple units, the eager bidder is awarded the security, and the auction continues, with the auctioneer selling the remaining securities at progressively lower prices. The strategic decision is identical to that of the first-price sealed-bid auction: The optimal bidder does not want to be too aggressive and stop the auction well above the likely market consensus, but will shade his or her bid to avoid the winner's curse. In other words, what market participants refer to as an English auction is strategically identical to what academics refer to as a Dutch auction. As a result, investors have the same incentive to pool bids and place customer orders at dealers.

#### ASCENDING-PRICE OPEN-OUTCRY AUCTION

The auctioneer can just as well cry out an ascending sequence of prices to the gathered bidders, stopping the auction when enough are willing to take down the total issue. Such a price sequence is plotted in diagram 4 for the auction of a single good or security. (Diagram 4 omitted) In keeping with the mirror imaging, academics term this an English auction.(5)

The auction of multiple units of a security begins as a price is called out and all interested parties submit their quantities demanded. The volume of bids at that price is announced and, in successive rounds, the price is

raised until the volume demanded is smaller than the issue. When that point is reached, the seller knows that the price just previously called out is the highest price consistent with placing the entire issue--that is, it clears the primary market. Everyone who bids at the top price and some fraction of the bidders at the previous price not in the top group receive awards at that lower price. (6) As the auctioneer calls out an increasing price list, bidders receive news that participants prize the security more highly than those low quotes. In effect, the auctioneer's initial announcements rule out low-price outcomes, revealing that the true market value is probably higher. This increasing sequence of prices lessens the winner's curse. Besides, if an investor is truly alone in valuing the security highly, the auction stops before the price is pushed too far up when the other bidder drops out.

In 1961, Vickrey established that the four major auction formats provide equal proceeds to the seller when individual valuations are independent. Obviously, the Treasury market violates this assumption, as the value that bidders place on the security reflects an imperfect estimate of the price in subsequent market trading--that is, bidders in a Treasury auction care about the common value of the security. In the common-values case, as later researchers showed, an ascending-price open-outcry delivers the greatest proceeds to the seller under many circumstances. (7) Essentially, in such an auction, bidders condition their behavior on the highest expressed value of the security and shade their bids the least relative to the other formats.

#### THE POTENTIAL FOR PROFIT IN AUCTIONS

The current auction format elicits one form of strategic behavior: Because awards are priced at the bid, the participants have incentives to shade their bids to avoid the winner's curse. As a result, customers have an incentive to pool their bids with dealers so that a combination of bids can, by a law of large numbers, be appropriately cast. The auction format may encourage two other types of strategic behavior as well. First, a dealer may combine with a customer to corner a significant portion of one auction--70 percent under the current rules. This strategy is called single-dealer cornering. Second, a group of dealers can conspire to accomplish the same end; this strategy is called collusive combining. In a sealed-bid auction, to garner the lion's share of awards, the single strategist or the group need to make only a slightly more aggressive bid than the other participants expect. Indeed, the second-price auction, a popular candidate to replace the current format, may make these strategies less expensive for the purchasers than they would be under current practice. The strategic purchaser could corner the issue by bidding substantially more than the market consensus but pay a price closer to the mass distribution that marks the other bids.

Clearly, single-dealer cornering and collusive combining are similar. However, the informational requirements and incentives for these two types of strategic behavior vary across auction type, and actions taken to combat one might make the other more likely. To analyze collusive potential in auctions, one must first understand the incentive behind cornering an auction--or the way in which one variety of squeeze can work.

#### HOW A CORNER WORKS

The potential for profit in a corner, or squeeze, lies in the interaction of the three main trading forums for Treasury securities; the when-issued market, the Treasury auction, and the secondary market. Those markets are represented by the three panels of diagram 5, arrayed by time--before, at, and after the auction. (Diagram 5 omitted) As the right panel shows, the price of a Treasury security must satisfy the ultimate holders of securities (pension funds, insurance companies, mutual funds, and the general investing public), seen as the intersection of their downwardly sloped demand schedule with the vertical Treasury supply schedule.

Current auction procedures, however, get securities to those holders indirectly, through the intermediation of dealers. As the middle panel shows, the demand derived from current and anticipated customer orders produces a flatter and more inward schedule at the auction as a result of the shading of bids in the attempt to avoid the winner's curse.

An investor can purchase the security before the auction, as long as he or she can find someone willing to sell it short. The when-issued market, shown in the left panel, matches those parties. Those seeking secure ownership rights trace a downwardly sloped demand schedule, while those willing to sell what they do not yet have make up the short-sale schedule. Selling a security before the auction involves a risk, as short sellers may not win awards at the auction to cover their open positions and so will have to borrow or buy the security after the auction settles to make delivery. Accordingly, the when-issued price should clear above the expected auction price.

The cornering of an auction is depicted in diagram 6. (Diagram 6 omitted) Short sales are made at a price just enough above the anticipated auction price to pay the sellers for exposing themselves to the likely risk at the auction. Those sellers, however, turn out to be wrong about the auction for, while the market consensus coalesces around bids consistent with the Demand schedule in the middle panel, one party comes in with bids that shift the actual schedule to Demand'. The cornerer exploits the sealed-bid nature of the auction: By bettering the market consensus, the schemer wins the bulk of the awards (measured by the horizontal distance between the two demand schedules). (8)

Since other parties cannot react, the Treasury receives only a modestly higher price for its auctioned securities, but the major price action awaits secondary market trading. The cornerer restricts the supply of the security in the secondary market (seen as the inward shift in the vertical supply schedule in the right panel), so that the price that clears that market is well above the auction price. From there, the cornerer slowly unwinds that position, expanding market supply to sell at prices above the ultimate level determined by the final owners of Treasuries. In effect, the cornerer acts as a discriminating monopolist, carefully regulating secondary market sales to earn all the revenue given by the area under the demand schedule. The cornerer's cost is given by the unshaded rectangle, leading to the profit given by the shaded area.

Indeed, the profit from a market squeeze may come by other means. While the issue remains in the cornerer's control during secondary trading, short sellers must borrow the security to make delivery. That transaction is one side of a repurchase agreement in which the owner of the desirable security--the cornerer--lends it to a short seller in return for cash at a preferential borrowing rate. In effect, by creating a demand for the issue, the cornerer can finance his or her position at a below-market borrowing rate.

The when-issued market plays two important roles in cornering strategy. First, early trading allows the market consensus to coalesce quickly and thus provides a usually accurate forecast of the auction price. By aiding in the "price discovery" of the appropriate price on the security to be auctioned, the when-issued market serves in tightening the spread of bids; thus, the cornerer needs to bid only slightly higher than that consensus to be assured awards. Second, a group of thwarted bidders--those who shorted in the when-issued market--are forced to the secondary market to close their positions. Their surprising presence makes the demand schedule less price sensitive, as no substitute exists for the security that they promised to deliver. As a result, as long as they keep their positions open, short sellers will need to borrow the desirable security and thus provide the cornerer favorable financing in the repurchase market.

The successful cornerer makes use of three elements of the current

practice:

\* When-issued trading creates a core of reliable demanders for the auctioned security (those who sold short).

\* The first-price method of allocating awards reduces demand at the auction and makes that demand more price sensitive.

\* Sealed bids allow a cornerer to place bids only marginally better than the consensus to win all the awards.

These characteristics of current procedures promise profit in successfully cornering a Treasury auction, although such trades are not without considerable risk. Even slight shifts in the prevailing level of interest rates could more than wipe out the profit from controlling a significant portion of an outstanding issue.

#### THE POTENTIAL FOR COLLUSION

One dealer with adequate capital and the willingness to be exposed to substantial risk can possibly take advantage in the current market. A harder problem to assess is whether or not an auction's design may entice a group of dealers to conspire in an attempt to corner. The theoretical analysis of the incentives for collusion in auctions proceeds as follows.

Let us suppose that a few dealers, intent on extracting profit from those not in the ring, willfully plan together to purchase all that is sold at an auction. They agree on a price just above the market consensus that is sure to win all the awards. A sealed-bid auction, however, tempts each of the conspirators to move just above the agreed-upon price and to steal awards; as a result, the cartel likely will not hold.<sup>(9)</sup> Hence, on the one hand, incentives in the classic first-price sealed-bid auction are structured so as to make collusion unlikely. On the other hand, in an ascending-price open-outcry auction, such a conniver among conspirators has to show his or her hand, making such manipulation less likely. Even if bidding is secret, the other members of the cartel will know by the price movement that someone has cheated. The cartel will hold.

By this theoretical argument, one might surmise that the current first-price sealed-bid auction protects, at least, against the willful joining of dealers to exploit the Treasury and other dealers. Unfortunately, a gap exists between models and reality, as the rule limiting awards to 35 percent of the issue paradoxically turns incentives back toward collusion. If a conniver plays within the lines of the 35 percent rule, he or she will not win enough securities at the auction to control the secondary market. Consequently, tough enforcement of quantity limits more strongly binds conspirators together.

More to the point, theoretical analyses of collusion assume that a small number of colluding parties share information, an assumption that ignores the multiple arenas in which dealers compete. Dealers will not cooperate in auctions if such cooperation jeopardizes their trading in the secondary market. Given the large number of participants and the apparent mistrust among dealers, auction format is unlikely to bring them together.<sup>(10)</sup> Thus, from the standpoint of public policy, the chief risk seems to lie in the manipulative actions of a single dealer, the rogue with capital, which threaten the integrity of the market.

#### A CLOSER LOOK AT A POPULAR PROPOSAL FOR REFORM

The abuses of the auction rules last summer rekindled enthusiasm for a simple alternative, the second-price sealed-bid auction, to the current discriminatory pricing practice. Proponents argue that awarding securities at a uniform price rather than at the bid prices would end cornering attempts by eliminating the profit potential in market manipulation. And in a way that sounds contradictory, they argue that total revenue would

increase by the surrender of the ability to discriminate across bids.

#### THE CONSEQUENCES FOR REVENUE

The algebra required to calculate an optimal bidding plan in a multiple-unit auction quickly becomes intractable. No analyst yet has worked through the strategic implications of a large core of bidders carving up a block of securities. The logic of the single-unit case, however, suggests that the extent of bid shading can be extreme. In a first-price auction of multiple units, a strategic bidder does not have to beat the participant with the next highest valuation to win but must better only the middle of the pack of bidders.

If one steps away from the explicit modeling of bidder behavior, the implications for revenue can be spelled out in terms of shifts in the demand schedule for the auctioned security.<sup>(11)</sup> As shown in diagram 7 (which repeats the middle panel of the three-figured determination of market prices), part of the Treasury's total revenue results from its charging winners the price that they bid, which for its current practice is measured by the area under the demand schedule labeled "First price." (Diagram 7 omitted) That price discrimination, however, discourages some demand, as investors shade their bids for fear of the winner's curse. Adopting a second-price system turns part of that surplus back to the bidders, shifting out the demand schedule to the position labeled "Second price." Under a first-price scheme, the Treasury would have to work down the left demand schedule and award securities at lower prices to place the total issue (marked by the vertical dashed line). Under the second-price scheme, one price, depicted by the horizontal line drawn to intersect the right demand schedule at the issuance size, exhausts the issue. The consequences for revenue depend on whether or not the loss from the inability to price discriminate (left triangle) is greater than the gain from added demand (right triangle).

Support for the second-price scheme is stronger than the balancing of these welfare triangles would suggest. Those analysts working with explicit models of bidder behavior in a Treasury-like format, rather than with reduced-form demand schedules, typically find that a second-price scheme does produce higher revenue for the seller. Further, in 1962 Milton Friedman made a persuasive argument that revenue would increase.<sup>(12)</sup> Dealers devote considerable energy to the auction only to sell those securities almost immediately to customers--and most profit from doing so. Part of the resources devoted to that distribution could be appropriated by the Treasury if it could directly deal with those customers. A second-price auction, because it is less penalizing to the aggressive or the uninformed, may be the best vehicle to attract those people.

#### THE CONSEQUENCES FOR CORNERING

As seen previously, the current format reduces demand at auctions and makes it more sensitive to price in relation to the demand determined by the buy-and-hold ownership of the long-time investor. This reduction is the rational response to the Treasury's discriminating pricing: The investor shows less of his true consumer surplus to a seller whose stated intention is to seize it.

Moving to a common-price format permits demand at the auction to reflect the true nature of investor preference. With no friction, investors can bypass the dealer intermediaries and bid directly, sharing the resulting savings with the Treasury. Viewed in terms of the three-figured determination of Treasury prices, second-price awards would make the auction demand curve identical to the secondary market demand curve (diagram 8). (Diagram 8 omitted) Against this backdrop, the cornerer of an auction would place surprising bids that shift the demand schedule from Demand to Demand'. The horizontal distance of that shift represents the cornerer's awards, or the extent to which secondary market supply can be restricted. As seen in the right panel of the figure, however, the investors who are unwilling to pay the auction price will be unwilling to

pay the secondary market price. Now the cornerer acting as a discriminating monopolist, rather than maximizing profit, minimizes loss (the shaded triangle). Clearly, one cannot profit from cornering a market with invariant demand, because one ultimately must sell the security to those from whom it was bid away. In this simple world, cornering would be eliminated by the removal of the potential for profit.

This result, however, requires that the switch in auction technique completely unify the primary and secondary markets. Even after the adoption of common-price awards, presence at auctions may still be limited to a segment of the investor populace, perhaps to those who are more sensitive to price. Those who sold short in the when-issued market want quickly to cover their positions at the auction. Also, participants at an auction face uncertain outcomes, since they may not be awarded securities if they have not cast their bids appropriately. Those particularly averse to this quantity risk may well delay purchase to secondary trading. Most important, direct bidding requires incurring the fixed costs of ensuring payment and arranging for the placement of bids the prospects for which depend on the pace of automation and the nature of regulation. As a result, the infrequent purchaser may remain in the secondary market. In other words, advocates of this format assume that dealers exist solely to shade bids because of the Treasury's discriminatory pricing. If, however, dealers provide any other service in the distribution of securities, then a gap remains between the demand schedules of the auction and the secondary market. A sufficiently large gap represents an opportunity for manipulation. Indeed, second-price awards might encourage strategems should differences between primary and secondary markets remain. A would-be manipulator could place bids for a substantial fraction of an issue well above the market consensus, and thus ensure awards, but pay only that price required to allocate the remaining portion of securities to his or her unsuspecting competitors.

#### AN ALTERNATIVE PROPOSAL

On balance, the switch to single-price awards likely represents an improvement on current Treasury practice; however, the Joint Report recommended the study of a more radical change. Collusive behavior relies on the closed nature of sealed bids--whether in the current first-price procedure or in the second-price alternative. A schemer needs only to beat the market's best guess formed moments before bidding closes in order to leave his or her competitors no chance to react.

An open-outcry system lets other market participants react to any surprise. Technologically, pieces of paper are not needed for the expression of the intent to purchase Treasury securities. As an alternative, registered dealers could connect by phone (with appropriately designed security) to a central computer; those not preregistered could appear at their local Reserve Bank with sufficient documentation to be included as a serious bidder. The scenario might unfold as follows. The auction begins as the Treasury calls out a price and all interested parties submit their quantity demanded. With quick tabulation, the volume of bids at that price is announced and, in successive rounds, the price is raised until the volume demanded is smaller than the size of the issuance. The next-to-last price called out clears the auction market because it is the highest price consistent with selling the entire issue. Everyone who bid at the top price would be guaranteed awards at the lower, market-clearing price. Those who bid at the next-to-last price but who did not move up into the top group receive the remaining securities at that lower price. Since bids from that group would exceed the remaining securities, some scheme for partial awards would be required.

Strategically, a dealer attempting to corner this auction must show his or her hand to the competition as the Treasury auctioneer raises the price. But the public exposure of the manipulator's addition to the volume of bids warns other participants--particularly those short the when-issued security--that they must raise their own bids if they want to receive



awards. That opportunity for others to react should narrow the potential for profit in a corner attempt. To the extent that the average issuing price is raised in the attempt, the Treasury garners part of the profits. In contrast, in a sealed-bid auction, the bulk of the price action comes at the announcement of surprising awards, when other dealers realize that they are short and then react. In a real-time auction, that reaction occurs during the bidding. Also, the positive information revealed by the ascending-price nature of this auction format, on average, should benefit Treasury revenue.

A real-time auction may pose a daunting technical challenge. The goal of equal access requires that every effort be made to decentralize the system: Anyone willing to pay the fixed cost of a properly configured terminal should be allowed to enter. At the same time, all bidders must be screened to ensure payment if their bids are successful. If the fixed cost of entry is too large, participation at the auction will be limited and a two-tiered distribution of securities and all the attendant risks may be perpetuated. If access is too free, the physical demands of directing a large volume of messages in a narrow span of time may prove taxing to any computer network. The private sector provides some precedent, but those efforts are small relative to the scale of operation required to sell Treasury securities.

Opening the auction might create new opportunities for large traders to move prices. For example, the surprising presence of a large trader elevating demand during the early stages of an auction might lead to a groundswell of enthusiasm that would push up the market-clearing price.<sup>(13)</sup> Similarly, the sudden dropping out by a large trader at a low price might dampen spirits enough to lower the market-clearing price. Either action might present the potential for profit. Also, as long as the three trading forums in Treasury securities are imperfectly integrated, the possibility of a market squeeze remains. At the least, an open-outcry auction does not abet a squeeze attempt by facilitating the bidding away of securities by surprise, as both types of sealed-bid auctions do. Thus, the Treasury would be less likely to be the counterparty from which a manipulator amassed a controlling position. Further, with easy entry, large traders would be pitted against each other in their pursuit of trading profits, as an open-outcry system turns market forces against market manipulation. As an added benefit, the technical sophistication required to conduct an automated open-outcry system could also be made available for surveillance regarding compliance with the auction rules.

## CONCLUSION

While the academic literature suggests that the current Treasury procedure has drawbacks, it does not readily identify the best way to auction government securities. Individual elements of the problem are addressed, but other considerations do not fit nicely into the theoretical models. The Treasury is obliged to provide easy entry into the auctions, broadening, where possible, the ownership of the public debt; and it must adhere closely to a crowded schedule of borrowing. Also, while the Treasury may not always get top dollar for its issues, the present auction system may ease the conduct of monetary policy and ensure a deep and active secondary market in government obligations.

The shift to single-price awards may mark an improvement over the current technique, but it may not avoid the repetition of recent experience. No matter how rigidly rules are enforced, the incentive to manipulate the market remains.

This reading of the literature suggests that the optimal Treasury auction would have the following attributes (in order of decreasing importance):

\* **SECOND PRICE.** If all securities are awarded at the lowest price of an accepted bid, investors wary of the winner's curse may enter the auction directly. Such entrance raises total demand because bidders no longer feel the need to shade their bids. Also, by making direct bidding more attractive, individual dealers will no longer have as much access to

customer business in attempts to swing the market.

\* REAL TIME. Auctions involving many participants that are conducted on an open-outcry basis are less susceptible to corners, which rely on surprise. In a sealed-bid auction, such surprise requires only stepping above the market consensus. That surprise is lost if market participants can react during the bidding.

\* ASCENDING PRICE. If the auctioneer calls out an ascending list of prices until the issue is sold, the surprise of a cornering attempt is further eroded. Simply, other participants remain in the bidding. Also, an ascending-price auction produces the highest expected revenue to the seller.

In this regard, the open outcry of bids is a form of insurance against threats to the integrity of trading: An auction in real time makes active manipulation more difficult. As a side benefit, an open-outcry auction returns some of the potential profit from collusion to the Treasury in the form of higher prices.

There are no guarantees that any system will prevent manipulation. Any new system, however, should be flexible enough to permit experimentation with auction design. Planning for an open-outcry system may provide the requisite flexibility.

A transition to a new auction system has potential problems, as any reform is likely to be designed to entice investors to bid directly. Investors, however, may be hesitant at first to step in, preferring to observe before acting, especially if bidding has a substantial fixed cost. In the interim between the change in format and direct participation by investors, the auction would rely on dealers for their usual role--buying a large share of issuance--even though the reforms would ultimately erode their customer base and lessen their market power. If dealers left the market before final investors appeared, experimentation with alternative auction techniques might prove expensive. However, if access to the auction were kept as open as possible, scores of price-sensitive investors in the Treasury market might step in should auction prices differ markedly from those in secondary trading. Indeed, the threat of entry in itself might be sufficient to lessen the risk of an adverse reaction.

1. William Vickrey, "Counterspeculation, Auctions, and Competitive Sealed Tenders," *Journal of Finance*, vol. 16 (March 1961), pp. 8-37.

2. Treasury auctions are actually conducted in terms of yields; for convenience. I discuss them in terms of price.

3. James L. Smith, "Non-Aggressive Bidding Behavior and the 'Winner's Curse,'" *Economic Inquiry*, vol. 19 (July 1981), pp. 380-88.

4. Milton Friedman, "How to Sell Government Securities," *Wall Street Journal*, August 28, 1991. Merton Miller also has embraced this reform, as quoted in Diana B. Henrique, "Treasury's Troubled Auctions," *New York Times*, September 15, 1991.

5. Indeed, in the private-values model (which we do not analyze), another equivalence proposition holds: what market participants refer to as a Dutch auction is strategically identical to what academics refer to as an English auction --unless there is a time limit on the bidding, in which case it is called a Scotch auction.

6. Those partial awards might go to those who were electronically timed as placing the earliest bids or to all bidders on a pro rata basis.

7. This was shown formally by Paul Milgrom and Robert J. Weber, "A Theory of Auctions and Competitive Bidding," *Econometrica*, vol. 50 (September 1982), pp. 1089-122, theorem 11.

8. A manipulator could bypass the auction by amassing a controlling position in either when-issued or secondary market trading. To effect that strategy, purchase orders would have to be spread across many sellers in an effort to hide the intent to corner from the general market.

9. This outcome also holds for a descending-price open-outcry auction. The first one to leave the pool stops the auction before the others can react.

10. The existence of interdealer brokers is one sign of the level of mistrust among dealers. These intermediaries provide anonymity to dealers in transactions between dealers, who are reluctant to phone their competition directly and to show which side of the market they are on.

11. For details, see Henry Goldstein, "The Friedman Proposal for Auctioning Treasury Bills." *Journal of Political Economy*, vol. 70 (August 1962), pp. 386-92.

12. From correspondence quoted in Goldstein, "The Friedman Proposal," p. 391.

13. See the description of the "herd effect" provided by Gary L. Gastineau and Robert A. Jarrow, "Large-Trader Impact and Market Regulation," *Financial Analysts Journal* (July/August 1991), pp.451.

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Vincent Reinhart, of the Board's Division of Monetary Affairs, prepared this article.

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GEOGRAPHIC NAMES: US

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CLASSIFICATION CODES: 3400 (CN=Investment analysis); 9190 (CN=United States)

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8/9/1 (Item 1 from file: 16)

DIALOG(R)File 16:Gale Group PROMT(R)

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01401293 Supplier Number: 41670087 (THIS IS THE FULLTEXT)

**CAN CAPITALINK BREAK SYNDICATE?**

Investment Dealers' Digest, p18

Nov 12, 1990

ISSN: 0021-0080

Language: English Record Type: Fulltext

Document Type: Magazine/Journal; Trade

Word Count: 4087

TEXT:

By Michael Liebowitz

ON WEDNESDAY, SEPTEMBER 26, the future arrived in the US capital markets. It was promptly blown away by Wall Street.

CapitaLink Bond Auction Systems, the computerized auction network designed as a low cost distribution mechanism for new corporate debt issues, was invited to join Merrill Lynch and Goldman, Sachs & Co. in a competitive "talk off" for a \$100 million issue of three-year notes by John Deere Capital, the finance subsidiary of the farm equipment manufacturer, Deere & Co. The invitation was a momentous first for CapitaLink, which has been hailed as the cutting edge of technology in the securities industry.

Deere, taking advantage of a shelf registration that had specified CapitaLink as a potential underwriter, asked CapitaLink, Merrill and Goldman to give it preliminary pricing indications.

The CapitaLink group, with the assistance of their partners at J.P. Morgan Securities, sprang into action and canvassed a sampling of Capitalink's 136-member investor base. They told Deere that it could expect to sell the securities at a spread to Treasuries of 80 basis points, not including fees.

CapitaLink never made it to the final round. Merrill weighed in with an aggressive all-in bid of about 85 basis points over Treasuries. The notes were subsequently re-offered to the public at 70 over.

Market conditions hadn't helped CapitaLink. At the time of the bidding, the debt markets were in a near-paralysis, due to the recent invasion of Kuwait by Iraq.

In a letter to its investors after the bid, CapitaLink thanked them for their input and concluded that "although we had strong hopes of conducting our first auction ... given the uncertainties in the financial markets, we agree that Deere was prudent in opting for a firmly underwritten deal in this instance."

Certainly there was no shame in losing the talk-off: firms lose such competitions all the time. CapitaLink will certainly be invited into other "talk-offs" and may win some. But issues raised by its debut performance, not least of which was the way the Street reacted to electronic competition, raised serious questions about the viability of CapitaLink.

From the beginning, the reaction of bulge bracket firms to CapitaLink has been hostile. Merrill Lynch led the charge against the system, seeing it as a fundamental threat to the corporate bond underwriting business.

Earlier this year, after Deere added language to its shelf registration allowing for the possibility of electronic issuance, Merrill said it would not help to market or even provide secondary market liquidity for any security issued through CapitaLink.

In the most forthright of a series of internal memos, dated March 30, 1990, Richard Fuscone, president and chairman of Merrill Lynch Money Markets, and Edson Mitchell, sr. managing director and head of global debt financing, wrote that "it is important that clients (both issuers and investors) understand this before they buy or issue a bond or note through CapitaLink or any other auction process. This is a firm policy to which there will be no exception. The inherent disadvantages of the CapitaLink approach, as well as the competitive threat it poses to our industry,

cannot be overemphasized."

Ironically, Merrill's corporate policy turned out to be nice publicity for the fledgling CapitaLink when it appeared in Forbes under the title "Bond Bully." In a time when the disintermediation of Wall Street is a fashionable topic, CapitaLink is the perfect David to Wall Street's Goliaths.

(Officially, the firm says it does not believe CapitaLink is in the best interest of the issuer or investor, but it has lately become more cavalier on the subject. "What can you say about a system that has claimed its first deal is imminent for the last two years?" said Grant Kvalheim, managing director and head of Merrill's debt capital markets desk.)

But CapitaLink has yet to show that it can follow through. With the debt markets still in disarray, now is not the best time to be launching an alternative to the traditional debt underwriting system. And most important, it is not clear yet that CapitaLink really can offer issuers and investors a better system. Can CapitaLink succeed or is it merely a theoretically appealing idea that has no practical utility? Is it trying to fix something that is not necessarily broken?

CapitaLink was born in the imagination of its president, David Jeffrey, while he worked in the treasury department at Joseph Seagram & Sons from 1981 to 1986. There he was responsible for evaluating the seemingly endless stream of complex proposals from investment bankers. Sometimes, the complex deals did save money for the issuer.

Other times, Jeffrey recalls, it appeared that bankers would add new twists just for the sake of creating more complexity and, of course, higher fees. In some cases, the savings were offset by the fees, which led Jeffrey to consider whether an issuer's all-in cost could be lowered simply by facilitating a cheaper distribution method for, specifically, plain-vanilla debt transactions.

"It seemed to me that you definitely needed your investment banker for the more complex deals. There's no question about that, and what we're proposing is not to do away with them," he says. "But when you want to go to the market with something straightforward, I felt, 'Shouldn't you be able to go directly to the investors?' They're all sophisticated entities and there are not that many of them. The only thing keeping them from buying direct was that there was no system that would allow an issuer to solicit and respond to direct bids."

Jeffrey wrote a business plan in 1985, and a year later raised some seed money from the Rochdale Corporation, a New York-based holding company that comprises a securities firm and an investment management firm. Jeffrey still had some initial trouble gaining access to the highest echelons of most corporations. It was then that he decided to team up with a major financial services firm.

Although Jeffrey held talks with a number of "substantial entities," J.P. Morgan was the most enthusiastic about the system, especially at the time when it was constrained from underwriting or trading corporate debt. (J.P. Morgan received permission to engage in these activities in January 1989 but had to wait until June 1989 to be able to execute transactions.)

"No one was really pushing forward to follow up the way Morgan was," Jeffrey remembers. Morgan became an investor in early 1989, and has built up its stake to 20% of CapitaLink's non-voting stock and 4.9% of its voting stock. Jeffrey declines to discuss Rochdale's stake, though he did say it was "not less" than Morgan's holdings.

At this point, CapitaLink has signed on 136 investors, only one of which has less than \$1 billion under management, and 29 of which are broker-dealers. Additionally, 17 issuers have filed with the SEC, including McDonald's Corp., General Electric Capital, AVCO Financial, Household Finance, Johnson & Johnson, Associates Corp. of North America, Pepsico and, most recently, General Mills.

The system operates similarly to a so-called Dutch auction. Investors, or "bidders," are notified in advance by telephone that an auction will take place. Both CapitaLink and J.P. Morgan's salesforce will engage in a bit of premarketing to make sure the auction will clear at a realistic rate.

During the half-hour auction process, investors bid at a spread to a

benchmark Treasury security, depending on the maturity of the issue. The highest spread that will clear the auction represents the final pricing. That spread will be spotted to the prevailing Treasury to provide a coupon on the issue. That price does not include fees, which are paid upfront to CapitaLink by the issuer and are divided equally with Morgan.

The bidding process is dynamic and open. Investors, whose identity is concealed by two-letter codes, can change their bids at any time during the half-hour process and may enter up to six different bids, allowing them to spread their demand over different levels.

The catch is, an investor can only adjust his position so that it is, in aggregate, larger in size or more aggressive. Although he can delete a particular bid, an investor cannot pull out of the auction altogether. The rationale is that CapitaLink wants the information on the screens to be real so as not to mislead other investors.

Unlike a blind auction, bidders can see the sizes and bids throughout the auction and adjust their bidding appropriately. One of the shortcomings of the typical Dutch auction process is that nobody understands where the market is, so the process does not provide any beneficial information to investors.

"When I first conceived of this idea, it was to save fees, but the more positive reaction we have gotten is not so much the fee savings but the information shown. What you're looking at (during an auction) is equivalent to looking at the lead underwriter's book," Jeffrey said.

Therein lies one important difference. The open screen system causes investors to react in a way that reflects the "truth" in the market. In traditional "bought" deal scenarios, Wall Street firms are not pricing to the last bond, but perhaps to 75 percent of the demand. "The investment banks are not showing what the true market interest is as they are building their books, because they have a closed-book process. Our system shows everyone where the pricing is and could bring out demand" as a result, Jeffrey said.

Furthermore, CapitaLink provides a service to the issuer who is concerned where its bonds get placed, according to John Graham, managing director at J.P. Morgan Securities, and the point man for CapitaLink. "One of the things issuers have found interesting about CapitaLink is the information they would get from doing an auction - as far as who buys their bonds," he said.

That information is often difficult to get from underwriters. Yet, Graham says, more issuers want it for investor relations purposes as debt is a more important part of their capital structure.

CapitaLink, which does see the names of the investors bidding during an auction, can easily provide an accurate computer-generated portrait of the buyers. Armed with information on who might be bidding, an issuer is permitted to limit the amount any one investor may bid on.

Nevertheless, many syndicate and capital markets pros point out that the Dutch auction method of distribution has, by definition, an inherent flaw. Any issue executed through a Dutch auction necessarily gets priced to the marginal buyer. In other words, the investor with the most extreme bid sets the price for all the investors. This is fine for the investors, but it tends to raise the cost to the issuer. And in CapitaLink's case, it practically invites undercutting by traditional underwriters.

During price discovery, it is conceivable that an underwriter could price the deal tighter and be long the 20% "tail," where the fees from 80% of the deal go to subsidize the remainder. "You cannot persuade CapitaLink to pay up five basis points for bids like underwriters do," said one Salomon syndicate official. In some respects, "CapitaLink could fail by its own merits."

Furthermore, the half-hour time frame of the auction and the fact that investors' bids are irrevocable agreements could together expose investors to underlying spread risk. "Almost regardless of the time of day, a half hour can be an important period of time and the market can move dramatically," says Zane Brown, exec. v.p. and head of the bond department at Equitable Capital Management Corp., which is not signed up with CapitaLink.

In response, Jeffrey admits that "to the extent that happens in the

middle of an auction, that is a risk to investors." But it is a small risk, he adds, noting that an investor could minimize the risk by bidding in the last moments of the auction.

What if all the investors took that approach? "In that situation, it definitely defeats some of the benefits of having an auction in a stable market where people are willing to show interest over time," he said. "But, we don't view this as needing to be a real long process. We're only running a half-hour auction now to make sure (investors) get on the system and are comfortable. When this becomes accepted, auctions could run at five or even one minute."

There is an important safety valve: If the Treasury market moves 15 basis points in either direction, the auction is called off, and all bids are null and void.

Although J.P. Morgan Securities can bid in the auction itself (it is not legally precluded from doing so), it will not act as a backstop guarantor of a tight clearing level. In the initial auctions, Morgan will not bid.

However, there remains one potent, secret weapon that Wall Street wields against CapitaLink: deliberate undercutting in price. Bill Clarke, associate at CapitaLink, said that salespeople on the Street call him to tell him that whatever CapitaLink does, the Street will invariably beat it by a basis point.

Whether for reasons of climbing up the league tables or going to bat for a client to win future, higher margin business, the Street has always subsidized frequent issuers for the last couple of years.

For that reason, an issuer like GECC, which is never shy about selecting an underwriter for a basis point's savings, might pass over CapitaLink if it can continue to get subsidized by 10 to 15 basis points through the market every time it issues.

"Most frequent issuers who might benefit from a technological link to investors are those who have been taking advantage of people on the Street for the last couple of years," a syndicate official said. "The kind of issuers signing up for CapitaLink are the last people who would save anything by using it. They are the most aggressive in the capital markets. If, collectively the Street doesn't make much money on these deals, how could they save money? If we're crazy enough to (bid aggressively), why should they give that up?"

Jeffrey concedes that the investment banks have the ability to consistently undercut CapitaLink. "If you have a type of situation when investment banks provide aggressive pricing, we're not going to give much savings," he says.

The guiding principle behind CapitaLink works from the assumption that underwriters earn full fees on all underwritten deals and that their compensation results from taking risks as principals as well as to support overhead like salesforces and screens. If that were the case, then CapitaLink's raison d'etre - cutting out the middle man - would perhaps be more persuasive.

The reality, though, is that unless a deal is negotiated and basically presold before final pricing, underwriters do not get rich from underwriting. "If one were to take the gross volume of debt issuance, multiply it by stated fees and then compare it to the Street's profitability, you'd see a big hole in the middle," says Merrill's Kvalheim.

In addition, it would be naive to think that all bonds are sold on a cash basis. CapitaLink cannot employ the valuable syndicate tools of distributing bonds on a swap basis to investors (exchanging older, fungible bonds for the new ones) or on a soft-dollar basis.

Furthermore, at this point CapitaLink cannot do deals via reverse inquiry, a common practice whereby an investment bank talks with investors to learn of demand for a particular type of security. That knowledge can be taken to an issuer, and a deal can be structured such that both parties are satisfied. CapitaLink officials say, however, that later evolutions of electronic market-making could allow for something like reverse inquiry to happen.

However, not all trends go against CapitaLink. For instance, the



Street's practice of aggressive pricing often has alienated investors. "It is almost universal with investors we spoke with that there were times when they had been told by salesmen that a deal was going fast, they wound up buying, and then later found the deal was 25% unsold," said Graham. "Then, they saw their competitor down the street buying at 10 basis points cheaper (in the aftermarket). If there's anything that really upsets investors, that's it."

The way in which many deals are done nowadays involves building a strong consensus from investors and essentially precircling the entire deal before actual pricing. But if underwriters are looking to investors to find out where the proper price is, CapitaLink (which is run by investors' view of the market) should do just as well, guaranteeing that a deal is fully sold.

In those cases, "one might wonder if much value is being generated by the underwriter to justify the fees it is requiring in that (sort of) transaction," Graham said. In the long run, companies will issue cheaper if they can avoid paying those risk premiums.

How do issuers feel about CapitaLink? Many of those interviewed for this story had not yet put the question to themselves. However, many pointed out that they would have had serious reservations about signing up had it not been for CapitaLink's affiliation with Morgan or some other major financial institution.

"We haven't looked into it that deeply," said Patrick Farrell, a company spokesman at Ralston-Purina. "We do a lot of work with Morgan on the banking side, and this was just a no-cost option to us."

"Our reason for including CapitaLink within our (\$1 billion) shelf was to provide for the potential for lower placement fees," said Brian Binyon, ass't treasurer at American General Corp. "It wasn't a terribly pro-active move. We don't have any definitive plans at this point, but we wanted to make sure we didn't preclude any options."

In any event, issuers seem reluctant to take a stand on CapitaLink. "My view is neither postive nor negative," said Jeff Werner, treasurer at GECC. "It's just another way to distribute bonds, and if it's cost-effective, we'll consider using it. I think we just haven't arrived at the conclusion that CapitaLink offers savings. As soon as we're convinced, we'll move more actively."

Since adding CapitaLink as one of many ways of distributing bonds costs nothing, it seems odd that more corporations have not already added the system to their list of options. What may be preventing them is that they are not frequent issuers of debt and, therefore, rely on investment bankers and salesmen to help market their names. What's more, many companies are loath to jeopardize their established relationships with their investment banks.

On the "investor" side, the 29 regional and second tier broker-dealers participating in the auction could stand to gain famously from the system. Generally, that is because the regionals have a tough time getting bonds from the bulge bracket, especially when the deals are hot.

The initial enthusiasm over CapitaLink perhaps reached its apex when, on May 4, 1990, the group was invited down to Richmond, Virginia to address a conference of regional dealers. The title of the presentation was "CapitaLink: Is this our way back into the corporate bond market?" Regional broker-dealers view CapitaLink as a way of being assured they will get bonds on a primary basis, which as one regional pro put it, "is a great alternative to begging for bonds from the Street."

"What's appealing about CapitaLink is that it allows us to participate, not only on a level playing field (with the majors), but with a dollar volume that's comfortable for us and our client base," said a debt syndicate official at a major Minneapolis-based regional firm, who declined to be named. "It may seem attractive to issuers to get bonds out to more hands and maybe save five or ten basis points."

On the one hand, the regionals applaud the concept of CapitaLink. But on the other hand, they fear that the smaller accounts could get filled up fairly quickly. "If it gets to the point where (our investors) are up to the limit on new names, maybe we wouldn't be as big a player anymore," the official says.

Regionals have to be political too. Sources say that some of the bulge firms have tried to convince the regionals not to play with the system, in return for being more forthcoming with securities. Regionals are not eager to hurt their relationships with those firms. "We're not out trying to take business away from bulge-bracket firms. That's the last thing we have in mind," the official says.

A final worrisome aspect of the bulge bracket's opposition to CapitaLink is the possibility of a lack of liquidity. The thrust of Merrill's attack on CapitaLink was that it would not make markets or provide liquidity for any CapitaLink-issued security, and most firms on the Street, while taking a more muted view, are in agreement with Merrill.

The liquidity issue is important because if Wall Street essentially boycotts CapitaLink deals, then J.P. Morgan will be the sole source of any sort of liquidity. The market's failure to provide secondary support would likely cause primary bids to rise, which in turn would cancel out any savings to the issuer.

That is because investors will demand a "back end" premium for the risk that they might have trouble selling their securities in the future at a decent price. "How many investors are going to trust J.P. Morgan's ability to provide a tight bid-reoffer?" queried one capital markets pro at a bulge firm. "The reason they buy from the bulge is that they know the Street is making a market in the name through good times and bad."

To some investors, liquidity is a troublesome point. "The issues that would be offered through the system do not offer value to us," says Equitable's Brown. "If they did offer value, though, it would be in the liquidity they afford. But the liquidity is questionable."

Furthermore, if Morgan does stand alone making two-way bids, it could be stuck holding the bag if issues fizzled out in the aftermarket. It is tough to hedge corporate bonds precisely. A 10 to 15 basis point widening on \$5 million inventory of a three-year issue like Deere's could quickly translate into a \$125,000 loss.

But J.P. Morgan Securities' Graham says the liquidity issue is somewhat of a moot point. "The fact that CapitaLink seems to have gotten as far as it has should lead you to question whether liquidity is everything it's cracked up to be in the secondary market," he says, noting accurately that very few bonds today have tight, two-way pricing in the secondary market.

"The number of investors who have signed up for, and their interest in, CapitaLink suggests that they do not view syndicate structure as a guarantee of liquidity," Graham said. "I question whether the people who pose the liquidity issue are holding CapitaLink to a higher standard than they themselves are providing to these investors."

Furthermore, Wall Street's commitment to boycotting CapitaLink issues is questionable. It is difficult to believe that Wall Street firms would not make a secondary market in securities if there was money to be made. Assuming CapitaLink gets over the first hurdle of a successful offering or two, "all the posturing will disappear and economic self-interest will emerge," notes Steven Wunsch, founder of Wunsch Auction Systems.

A dealer, too, would not want to cut off his nose to spite his face. In the long-run, those dealers who refuse to make markets will no longer be considered dealers by their customers. And issuers may no longer want to issue through underwriters who are viewed as non-players by investors.

At the moment, the jury is still out on CapitaLink. Although the system had hoped to do a deal before the summer was out, it has been constrained by external events affecting the market.

But in view of Wall Street's determination to maintain its franchise, it is hard to see how CapitaLink will clear that first hurdle. If the bond market were bullish now, it would not necessarily mean that CapitaLink would thrive: Wall Street would be even more eager to make aggressive bids and gamble on the market to bail them out.

At bottom, CapitaLink's success depends mostly on whether Wall Street can continue to add value. If CapitaLink can give investors and issuers better price and execution than the Street can, then it is inevitable that CapitaLink will succeed.

As one syndicate head, who wished to remain anonymous, put it: "If we

can't add value, then we're in trouble. If an issuer starts to use CapitaLink, I think it fundamentally sends the message that it is rejecting our services. It is like stereo shopping on Fifth Avenue and buying at Uncle Steve's."

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2/3,K/12 (Item 12 from file: 15)  
DIALOG(R)File 15:ABI/Inform(R)  
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00727091 93-76312

**Pool Prices, Contracts and Regulation in the British Electricity Supply Industry**

Helm, Dieter; Powell, Andrew  
Fiscal Studies v13n1 PP: 89-105 Feb 1992  
ISSN: 0143-5671 JRNL CODE: FCS  
WORD COUNT: 6755

...TEXT: section is an analysis of the form of competition in the pool. If the pool auction is indeed competitive, and the bid prices reflect marginal costs, then we must look for other exogenous factors to explain the rise in pool...

2/3,K/13 (Item 13 from file: 15)  
DIALOG(R)File 15:ABI/Inform(R)  
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00726596 93-75817

**An Analysis of Potential Treasury Auction Techniques**  
Reinhart, Vincent

Federal Reserve Bulletin v78n6 PP: 403-413 Jun 1992  
ISSN: 0014-9209 JRNL CODE: FRS  
WORD COUNT: 6545

...TEXT: those who sold short).

\* The first-price method of allocating awards reduces demand at the auction and makes that demand more price sensitive.

\* Sealed bids allow a cornerer to place bids only marginally better than the consensus to win all the awards.

These characteristics of current procedures promise...

2/3,K/15 (Item 2 from file: 16)  
DIALOG(R)File 16:Gale Group PROMT(R)  
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01401293 Supplier Number: 41670087 (USE FORMAT 7 FOR FULLTEXT)

**CAN CAPITALINK BREAK SYNDICATE?**

Investment Dealers' Digest, p18  
Nov 12, 1990  
Language: English Record Type: Fulltext  
Document Type: Magazine/Journal; Trade  
Word Count: 4087

... method of distribution has, by definition, an inherent flaw. Any issue executed through a Dutch auction necessarily gets priced to the marginal buyer. In other words, the investor with the most extreme bid sets the price for...

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**2/3,K/7 (Item 7 from file: 148)**

DIALOG(R)File 148:Gale Group Trade & Industry DB  
(c)2000 The Gale Group. All rts. reserv.

08536197 SUPPLIER NUMBER: 18059149 (USE FORMAT 7 OR 9 FOR FULL TEXT)  
**Copart: crash cow.(wrecked car auctioneers)**  
Croghan, Lore  
Financial World, v165, n4, p16(1)  
March 11, 1996  
ISSN: 0015-2064 LANGUAGE: English RECORD TYPE: Fulltext; Abstract  
WORD COUNT: 506 LINE COUNT: 00041

... consignment and collecting a fixed fee per car no matter how high,  
the vehicle's auction price. Copart prefers to auction cars under a  
~~higher-margin arrangement~~ called the Percentage Incentive Program, which  
means the company receives a percentage of the...

19960311

**2/3,K/8 (Item 8 from file: 148)**

DIALOG(R)File 148:Gale Group Trade & Industry DB  
(c)2000 The Gale Group. All rts. reserv.

08531974 SUPPLIER NUMBER: 17411914 (USE FORMAT 7 OR 9 FOR FULL TEXT)  
**Collision or coexistence: the FERC, the CPUC, and electric restructuring.**  
**(Federal Energy Regulatory Commission, California Public Utilities**  
**Commission)**  
Hollis, Sheila S.; Teichler, Stephen L.  
Public Utilities Fortnightly (1994), 133, n18, 19(5)  
Oct 1, 1995  
LANGUAGE: English RECORD TYPE: Fulltext; Abstract  
WORD COUNT: 3052 LINE COUNT: 00252

... a marketmaker, too? (\*)  
\* Pricing. Highest winning bid or lowest loser? (The so-called  
"second-price" auction.)  
\* Bid Rules. Allow a zero-price tender, or mandate a marginal-cost  
bid?  
\* Grid Constraints. Will bottleneck areas command economic rents? If  
so, what does the...

...a marketmaker, too? (\*)  
\* Pricing. Highest winning bid or lowest loser? (The so-called  
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\* Bid Rules. Allow a zero-price tender, or mandate a marginal-cost  
bid?  
\* Grid Constraints. Will bottleneck areas command economic rents? If  
so, what does the...

19951001

**2/3,K/13 (Item 13 from file: 148)**

DIALOG(R)File 148:Gale Group Trade & Industry DB  
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06587800 SUPPLIER NUMBER: 14547496  
**Treasury auction bids and the Salomon squeeze. (postauction prices of**  
**Salomon Brothers treasury notes)(includes appendix)**  
Jegadeesh, Narasimhan

Journal of Finance, v48, n4, p1403(17)

Sept, 1993

ISSN: 0022-1082

LANGUAGE: ENGLISH

RECORD TYPE: ABSTRACT

...ABSTRACT: claim that collusion is common practice in Treasury auctions and that as a result the auction profits are excessive. But, this paper finds that the auction prices are on average marginally higher than the secondary market bid prices. The auction profits, however, are systematically related to...

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**Auctions: Theory and applications**

Feldman, Robert A; Mehra, Rajnish

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**ABSTRACT:** Auctions play an important role in economics. In their most basic form, they are one of the ways in which various commodities and financial assets are allocated to individuals and firms, particularly in a market-oriented setting. The use of auction mechanisms to guide price determination and the allocation process can offer certain advantages which are discussed. A study assesses alternative auction techniques for pricing and allocating various financial instruments, such as government securities, central bank refinance credit, and foreign exchange. Before recommending appropriate formats for auctioning these items, the study discusses basic auction formats, assessing the advantages and disadvantages of each, based on the existing, mostly theoretical, literature. Auction techniques can be usefully employed for a broad range of items and their application is of particular relevance to the impetus in many parts of the world toward establishing market-oriented economies..

**TEXT:** Auctions play an important role in economics. In their most basic form, they are one of the ways in which various commodities and financial assets are allocated to individuals and firms, particularly in a market-oriented setting. Examples of items that are commonly auctioned include original art, livestock, fresh fish, used cars, construction contracts, and a range of financial assets such as government securities, central bank refinance credit, foreign exchange, and equity shares. These items exhibit considerable diversity, but a common denominator among them is that the valuation of each item varies enough to preclude any direct pricing schedule.

The use of auction mechanisms to guide price determination and the allocation process can offer certain advantages, which this paper discusses. The major effort taking place in many parts of the world to establish market-oriented institutions makes a paper on these mechanisms opportune. Against this background, one of the main goals of this paper is to survey the extensive literature on auctions in order to shed some light on the advantages and disadvantages of various auction techniques. (1) A second main goal is to assess the application of alternative auction techniques to various financial instruments, using the three examples of government securities, central bank refinance credit, and foreign exchange.

We emphasize that the implications of theoretical models do not easily carry over into real world settings. Therefore, our recommendations on the appropriate auction technique for different assets depend heavily on individual country circumstances. Indeed, the array of country experiences would suggest no clear-cut answer to the question of which is the appropriate auction technique. In this connection, it is instructive to note that in looking at individual country experiences across a range of countries--both industrial and developing--techniques used to auction similar items vary considerably.

This experience includes several countries that in auctioning government securities have awarded them at whatever price was bid (including France,

Germany, Japan, and the United Kingdom) and others that have charged a single, market-clearing price (Denmark and Switzerland). (2) Some countries have recently changed the way they run their auctions. Mexico in 1990 shifted from a multiple-price to a uniform-price approach for treasury bills and then in 1993 shifted back. (3) Italy in 1991 switched from uniform to multiple pricing in its local-currency treasury bill auctions, but has auctioned its treasury bonds and ECU-denominated bills on a uniform-price basis. Currently, in the United States, the U.S. Treasury is experimenting with uniform-price auctions for some government securities while also running discriminatory auctions.

Relevant examples are also found for foreign exchange and refinance credit. Several countries have conducted discriminatory-price or Dutch auctions for refinance credit (Romania) and for foreign exchange (Bolivia, Ghana, Jamaica, and Zambia). Other countries have used uniform-price auctions for refinance credit (the former Czechoslovakia) and for foreign exchange (Guinea, Nigeria, and Uganda). (4) Double auctions have been used for foreign exchange (Romania).

## I. TYPES OF AUCTIONS

An auction is simply an allocative mechanism. Since auctions can play a valuable role in the price discovery process, they are most useful in situations where the item being auctioned does not have a fixed or determinable market value or where the seller is uncertain about the market price. These situations typically involve some degree of informational and cost asymmetries in the sense that economic agents differ in their access to, and evaluation of, information pertaining to the auctioned commodity. Auctions may be for a single object or unit--as is typical in the proceedings of such well-known auction houses as Sotheby's and Christie's--or for a "lot" of nonidentical items, as with land tracts (a practice in many countries) or used cars (a practice in the wholesale U.S. automobile market). Alternatively, auctions may be for multiple units of a homogeneous item, such as gold or treasury securities.

Our concern in this paper is mostly with auctions for multiple homogeneous assets, such as government securities, refinance credit, and foreign exchange. The theoretical literature relies frequently, however, on the assumption of a single unit being auctioned. Partly for this reason, the definitions given below cover both single-and multiple-unit auctions. Of course, auctions of single units are also relevant in economics. For example, countries' efforts to privatize may involve auctioning a single item, such as a public enterprise.

Following the pioneering work of Vickery (1961), we distinguish between four primary types of auctions, classifying each according to its corresponding institutional arrangement. Each of the following classifications entails its own set of rules that affects the bidding strategies of the auction participants and therefore the outcome of the auction itself.

**English auction.** This type of auction is also referred to as an ascending price auction and is commonly seen in the art world. It is perhaps the most familiar form of auction. Starting with a low first bid or a specified reservation price--that is, a price below which the item will not be sold--the auctioneer solicits increasingly higher bids. As the bid price increases, there are normally fewer takers. The process continues in the case of a single item until that item is "sold!" to the last and highest bidder for the amount bid (see Figure 1a). (Figure 1a omitted) In an auction involving multiple units, the process continues until arriving at a price at which the fixed amount supplied at auction is just matched by total demand.

**Dutch auction.** This type of auction is also referred to as a descending-price auction. It gets its name from the technique used in the Netherlands for auctioning produce and fresh flowers. The bidding commences

at a high level and is progressively lowered until a buyer claims the item being auctioned by shouting "mine!" (see Figure 1b). (Figure 1b omitted) Practitioners have long since streamlined the proceedings through the use of an automated "clock" with a hand running counterclockwise through progressively lower prices. Any buyer can stop the descent by pressing a button when an acceptable price is reached. When multiple units are being auctioned, there are normally more willing takers as the price declines; this process continues until arriving at a price whereby the fixed amount supplied is just matched by total demand.

First-price auction. This type of auction is an example of a sealed-bid auction, as opposed to the above two formats, which are open auctions. The term "first price" is commonly used when referring to the sale of a single item. The highest bidder is awarded the item at a price equal to the amount bid. When multiple units are auctioned at the same time, this procedure is called a discriminatory auction. The sealed bids are sorted from high to low, and the auctioned items are awarded at the highest bid prices until the supply is exhausted. Thus, the auction discriminates among bidders in the sense that they can pay different prices according to the amount they bid (see Figure 1c). (Figure 1c omitted) The terminology "first-price" or "discriminatory" auction follows the academic literature. In the financial community--and here is where one source of confusion may arise--this type of auction is referred to as an English auction; an exception being in the United Kingdom where it is called an American auction. This type of auction is also referred to as a multiple-price (or, in some cases, a multiple-yield) auction.

Second-price auction. This type of auction is also a sealed-bid auction. When a single item is auctioned, the highest bidder is awarded the item at a price equal to the highest unsuccessful bid--hence, the name second price. The multiple-unit extension of the second-price, sealed-bid auction is referred to as a uniform-price auction (or competitive auction), since all winning bidders receive the auctioned items at the same price (see Figure 1d). (Figure 1d omitted) Here, some confusion in terminology also arises from the use of the term "second price" or "uniform price" auction because in the financial community these auctions are referred to as "Dutch auctions," although this would appear to be a misnomer.(5) This type of auction is also referred to as a marginal-price auction.

A final type of auction worthy of mention is a double auction. Using this format, both sellers and buyers submit bids, which are then ranked from highest to lowest to generate demand and supply profiles. From these profiles, the maximum quantity exchanged can be determined by matching sell offers, starting with the lowest price and moving up, with demand bids, starting with the highest price and moving down. The "equilibrium" price may, however, be indeterminate using this methodology.(6) An example of a double auction is the market-clearing mechanism in organized exchanges, like stock exchanges and commodity markets, where a specialist matches bid and ask prices in a "specialist's book," making the market for a particular security traded on the exchange.

In addition to the institutional arrangements governing the workings of a particular type of auction, a second aspect of classifying different auction mechanisms concerns how each bidder values the item(s) on the auction block. Economists customarily distinguish between "private-value" auctions and "common-value" auctions. The former term refers to objects acquired for personal consumption with no primary motive to resell. The bidder therefore has a personal maximum that he or she would be willing to pay, quite independent of the valuations of rival bidders. If this is the case, one speaks of the bidder as displaying "independent private values." A frequently cited example is an object of art purchased for personal pleasure rather than for profitable resale.

The same painting, however, can be purchased to be resold. The bid is then predicated on both personal valuation and the valuation of prospective buyers in the secondary market. This situation is referred to as the

common-value assumption because each bidder places the same value on the object--that is, each one tries to estimate what the object is ultimately worth on the basis of the same objective standard. This common value may be an unobservable variable at the time of the auction, as would be the case when a government security is purchased to be resold later in the secondary market.

In general, all auctions are "correlated-value auctions," a category that includes the common-value and private-value auctions as polar examples. This concept of correlated values captures the notion that in each auction situation, bidders' values are to some extent related to each other: they are correlated. Milgrom and Weber (1982) use the term "affiliation" to express the same idea more precisely. However, as Rasmusen (1990, p. 246) points out, "as always in modeling, we must trade off descriptive accuracy against simplicity, and private value versus common value is an appropriate simplification." We retain this distinction throughout the paper.

For the four basic types of auctions just defined, Table 1 summarizes the rules associated with each institutional arrangement (see Rasmusen (1990)). (7) (Table 1 omitted) It also outlines some simple aspects of the bidder's strategy, which are implied by the rules and payoffs to the bidder.

## II. AUCTION THEORY

Since auctions follow well-defined rules, they can be viewed as "games," making the application of game theory an appropriate paradigm for gaining insight into their dynamics. (8) But to gain these insights, the theoretical literature relies on a number of simplifying assumptions. Although these assumptions allow one to derive key results, they make the application of auction theory to real world settings an exercise to be undertaken with caution. In addition to reviewing some common assumptions, this section discusses auction strategy, first from the bidder's and then from the seller's perspective, before turning to issues of economic efficiency and the incentives to collude under different auction formats.

The assumptions most commonly used, depending on the context, are

- (1) Bidders are risk neutral (9)
- (2) Either the independent private-value assumption applies or the common-value assumption applies; and
- (3) The bidders are symmetric--that is, they use the same distribution function to estimate their valuations--implying bidders cannot discern differences among their competitors.

Following the earlier theoretical literature, it is initially assumed that one item is being auctioned.

### BIDDER'S PERSPECTIVE (10)

We briefly examine bidding strategies that emerge from the intersection of auction format rules with the earlier stated assumptions regarding bidder values.

### PRIVATE-VALUE ASSUMPTION

If, as is fairly standard, the English auction has a specified bid increment, then, in the limit, as the increment becomes infinitesimal, the English and second-price formats result in the same price and allocation, or more formally in the same "normal form." Similarly, the Dutch auction is strategically equivalent to the first-price, sealed-bid auction since there is a one-to-one mapping between the strategy sets and the equilibrium of the two games. In both of the latter formats, no relevant information is revealed in the course of the proceedings, only at the conclusion of the auction when it is too late for any bidder to act upon or change a bid. In

the first-price format, the bid is relevant only if it is the highest. Likewise, in the Dutch format, the stopping price or bid is irrelevant unless it is the highest (the winning bid stops the price descent).

#### COMMON-VALUE ASSUMPTION

Under this assumption the equivalence between the English and the second-price auction does not hold, (11) although between the Dutch and first-price auctions it continues to hold. See Milgrom and Weber (1982) and Smith (1987).

What optimal strategies evolve in the course of the competitive bidding process under the common-value assumption? Take the example of competitive bidding for a construction contract. In this case, the contract is awarded to the lowest bidder. Assume that bidders are identical except that their valuations are based on information to which they (differentially) have access. In calculating his or her bid, each player faces a trade-off between the probability of winning the contract and the expected profit if he or she does. If all contenders specify their bids by adding a markup to their estimated costs, the winning bid will have the lowest estimated project costs and will, on average, be too low. In the case of auctions for items such as art or mining rights, where the highest bidder wins, the winning bidder is faced with the realization that his or her assessment of the item's value exceeded all other bidders' assessments. That is to say, the highest bidder wins the auction but loses by decreasing his or her expected profit! This contrary observation is termed the "winner's curse." The best-known study in economic literature of this phenomenon is by Capen, Clapp, and Campbell (1971), who look at the bidding for offshore mining rights auctioned by the U.S. Government. One implication of the "winner's curse" is that inexperienced bidders profit less than expected since such bidders are more likely to place the highest bid when they have overestimated the value of the item. A bidder would be disconcerted to discover that he or she had outbid 20 experts! Experienced bidders are aware of the winner's curse and factor it into their calculations.

The winner's curse has several implications for optimal bidding strategies. In a first-price auction, for example, the winner by implication can expect a lower profit when he or she attempts to resell, since competing bidders display a lower valuation of the object. Being aware of this possibility, bidders are likely to "shade" their bids below their own estimates in an effort to move closer toward the market consensus. (12) Other things being equal, as the number of bidders increases, it is prudent to bid more conservatively, since the range of the distribution of bids, and thus the highest bid, is likely to expand with the number of bidders. Thus, the winner's curse is reinforced as the number of bidders increases, creating a greater shading of bids below their true estimate.

Second, the gap between the highest bid and the "true" value of the item decreases as the amount of information available about the auctioned item rises. The winner's curse is therefore muted by increasing information about the value of an auctioned item. With the curse muted, it is optimal for bidders to be less conservative in their bids, implying that, as more information is available, bidding will become more aggressive and the selling price will, on average, be higher.

Milgrom (1987, p. 6) provides a useful summing up: "The most important lessons to be learned...are that the returns in bidding come from cost and information advantages, that naive bidding strategies can squander these advantages and that bidders without some advantage have little hope of earning much profit, but could with a little bit of carelessness suffer large losses."

#### SELLER'S PERSPECTIVE

The two assumptions described above also influence and modify seller

behavior.

#### PRIVATE-VALUE ASSUMPTION

Under specific assumptions, the theoretical literature demonstrates that all four basic types of auctions will yield the same expected price and revenue to the seller.(13) This central result in auction theory, termed "the revenue equivalence theorem" (Vickery (1961)), assumes that bidders display symmetric and independent private values in auctions that are free of distortions and that have only a single unit sold. The theorem does not imply that every realization of the game, independent of the auction type, will yield the same price and revenue, only that the expected price and revenue are the same. The revenue equivalence theorem does imply, however, that the specific auction format chosen by the seller in this stylized theoretical world is not crucial, since each format yields, on average, the same payoffs to the seller.

A construct termed the "revelation principle" is used to prove a number of theoretical propositions in auction theory, including the revenue equivalence theorem. It describes the optimal mechanism from the seller's point of view.(14) The term "mechanism" in this context acts as a black box: a process that takes bids as inputs and produces the winning bidder and the winning price as outputs. Thus, each of the auction forms can be viewed as a mechanism. In a direct mechanism, each bidder is simply asked to report his or her personal valuation of the item. A mechanism is termed "incentive compatible" if the auction is structured in such a way that it is in the bidder's interest to state honestly his or her personal valuation of the object--for example, if the proceedings require each bidder to state a valuation and the object is awarded to the bidder with the highest valuation. Under the assumption of private value, this is precisely what occurs in the first-price, sealed-bid auction. Each bidder is optimizing when he or she submits the bid, and the revelation principle designs the payoff structure so as to make it optimal to be honest.

Note that the revelation principle is a purely theoretical construct, and few, if any, resource allocation procedures used in practice are direct incentive-compatible mechanisms. Its main application is to facilitate the search for a resource allocation mechanism that is optimal, subject to the constraints of asymmetric information.(15)

#### COMMON-VALUE ASSUMPTION

Under the set of common-value assumptions, we see different results and also move closer to some of the auctioned items with which we are concerned, such as government securities; in these auctions, assets are acquired with the intention of profitable resale in secondary markets. More specifically, it can be shown that the revenue equivalence theorem does not necessarily hold under the assumption of common values when, in determining a bid, an individual bidder faces common uncertainties, such as energy prices, pollution considerations, and changing consumer tastes, that might impinge on possible resale values. In these circumstances, Milgrom and Weber (1982) demonstrate that the expected revenue from selling a single object in one of the four auction formats can be ranked from highest to lowest:

- (1) The English, ascending-price auction;
- (2) The second-price, sealed-bid auction;
- (3) Tied: The Dutch auction and the first-price, sealed-bid auction.

The rankings clearly illustrate the advantage of increased information. As an English auction proceeds, it reveals information about rival bidders' valuations and permits a dynamic updating of an individual bidder's personal valuation. This updating results in more aggressive bidding,

thereby raising the seller's revenue. A first-price (discriminatory) auction awards the object to the highest bidder. Thus, other bidders place a lower value on the object, reducing the profit that the winning bidder can hope for in the resale market. In response, bidders in first-price auctions will tend to shade their bids well below their estimates, resulting in reduced revenue for the seller. The same reasoning applies to the strategically equivalent Dutch auction. In the second-price (uniform), sealed-bid format, by contrast, the winner pays the bid of the next highest bidder. Hence, bidders would tend to offer higher bids than in a first-price auction bid, secure in the knowledge that they will not be disadvantaged if rival bidders' valuations are much lower.

As we have seen, the theoretical analysis deals with bidders who demand only one indivisible unit of the commodity being auctioned. If bidders want more than one unit--as in the government securities market--and are allowed to submit bids for different quantities at different prices, then the above results need not hold. In particular, Maskin and Riley (1989) show that in the independent and private-value models the unit-demand assumption (in which each buyer wishes to purchase at most a single unit) is crucial for revenue equivalence results. The theoretical situation in which this assumption does not hold has not been fully worked out, but it is conjectured that the economic logic of the arguments for the single-object environment will carry over. No proposition states, however, that the revenue rankings given above will hold when the unit-demand assumption is relaxed.<sup>(16)</sup> Hence, on purely theoretical grounds one cannot assert that a particular auction format is superior to another. Indeed, one cannot overemphasize that the nuances and details of any particular auction are exceedingly important in deciding which format to use.

A number of theoretical studies have also suggested that uniform pricing is revenue superior to discriminatory pricing.<sup>(17)</sup> The crux of the matter is that in using a uniform-price format, the winner's curse is muted, owing to the linkage of the final auction price to the highest losing bid. Put simply, the essence of the "linkage principle" is that auctions yielding the highest payoffs to the seller are those that are most effective in undermining the benefit to bidders of holding private information, thus transferring some of the profits from bidder to seller. As Milgrom (1987, p. 4) puts it, "privacy is undermined by linking price to information other than (but correlated with) the winning bidder's private information."

In any auction format, the seller can influence bids, and hence the final payoffs, by revealing information about the auctioned object. Intuitively, an individual bidder's expected profit is highest when he or she can exploit information asymmetries--that is, when the bidder has access to useful information about the object's "equilibrium" value that is not held by other auction participants. In general, more accurate information about the item's "equilibrium" value mitigates the effect of the winner's curse, and hence the price-dampening effect of bidder caution.<sup>(18)</sup> Thus, the seller's optimal strategy is to reveal all available information and to link the price to exogenous indicators of value. If a seller adopts a policy of revealing information, the price becomes linked to the seller's information; this undermines the winner's surplus value, siphoning off some portion to the seller.<sup>(19)</sup>

#### EFFICIENCY CONSIDERATIONS

The theoretical literature on auctions puts less emphasis on economic efficiency than on other aspects of the various auction formats, such as their revenue-generating potential. Nevertheless, it is extremely important to underscore the efficiency of auctions.<sup>(20)</sup> Available evidence indicates that auctions, in the absence of distortions, function efficiently--that is, they ensure that resources accrue to those that value them most highly (and where they will be most productive) and that sellers achieve the maximum value for the auctioned item. It can be shown on theoretical grounds that there exists an equilibrium, arising from the competitively submitted bids, in which the auctioned item is allocated endogenously in an

efficient way when the price of the item is unknown. Empirical evidence also suggests that, in the absence of distortionary factors, auctions function efficiently.(21) In addition, the auction mechanism can achieve this objective more effectively than alternative trade arrangements, such as price setting by the seller or negotiation between buyer and seller.

Of the four auction formats, the English and second-price settings result in an efficient or Pareto-optimal allocation in the case of private-value auctions.(22) Complications arise in the case of the first-price, sealed bid auction and the Dutch (descending-price) auction. In the most commonly analyzed case of "symmetric" environments--where bidders are identical, draw their information from the same distribution, and cannot differentiate among their competitors--these auction formats are efficient. In general, however, with first-price, sealed-bid and Dutch formats, it is not optimal to bid one's reservation price, a condition that results in bid shading and consequently an inefficient allocation.(23)

In the case of common values, efficiency also requires the assumption that all bidders base their strategies on information drawn from the same distribution, as opposed to asymmetric information. Under the more realistic assumption that different bidders have private information, the analysis is not so straightforward. In particular, Maskin (1992) distinguishes between two cases: (a) where private information can be modeled as a scalar (that is, as a single item of information); and (b) where the bidders' private information can be represented by a vector (that is, by multiple units of information). In the former case, under fairly general conditions, the English auction is efficient but the uniform-price (second-price, sealed-bid) format is efficient only if there are two bidders. In this case, the first-price and the Dutch auctions will typically not be efficient except in highly restrictive cases. In the second case, when bidders have several items of private information, efficiency is unattainable in any auction format. It can be shown, however, that when the informational asymmetry among bidders is not too great, the English and second-price auctions function better than alternative formats.(24)

To summarize the evidence on efficiency, the auction of choice would be the English auction followed closely by the second-price, sealed-bid auction. The two formats are identical only in the case where there are two bidders.

#### COLLUSION

The extent to which incentives to collude vary under different auction formats can be of great practical concern in deciding on which type of auction to use. Indeed, the indictment in the United States of a primary securities dealer in 1991 for fraudulent activities in the government securities market has focused attention on the collusive potential of standard auction formats. These concerns are briefly dealt with below. It is important to keep in mind that all auctions are susceptible to collusive behavior--what we review here is the comparative incentive for collusion under different auction formats.

A basic hypothesis, first formulated in the literature by Mead (1987), is that ascending-bid formats are more susceptible to collusion than sealed-bid auctions. This belief may explain the popularity of sealed bidding, even though the ascending-bid format has superior revenue-generating potential. Intuitively, auction formats where covert "side deals" are possible are more likely to support bidder manipulation. Thus, an open-bid English auction is particularly vulnerable to manipulation, since a subset of bidders (a "ring") must simply agree not to outbid each other to effectively lower the winning bid. The item can then be reaucted among the ring members, and the profits shared. The open format inculcates adherence to the agreement since any ring member attempting to exploit the ring by a side deal of his or her own would, effectively, negate the ring and restore the auction to a competitive



footing. The open format ensures that compliance among ring members is easily monitored. It should be noted, however, that the problems with collusion under the English format should diminish as either the actual number of bidders or the potential number of bidders increases. Intuitively, for a ring to be successful it must have a significant proportion of the total number of bidders under its control. To achieve this result, it is advantageous to have no new bidders entering the auction. Further, with a higher number of actual bidders, it becomes more difficult to control a significant proportion of them, and more than one ring can form and try to outbid the others.

Sealed-bid auctions, by comparison, are vulnerable to collusion that involves the auctioneer--that is, between the auctioneer and one or more bidders, or between the auctioneer and the seller.<sup>(25)</sup> This format is, however, less prone to rings, since sealed bidding tempts the participants in any conspiracy to bid just above the agreed-on price, effectively dissolving the cartel. This result also holds true for the Dutch format, even though it is an open, instead of sealed-bid, auction, since the first bidder to defect from the ring ends the auction. As Smith (1987, p. 52) points out, the Dutch auction is perhaps most effective against collusion: "In this auction, since none of the losing bids is known to anyone, they cannot even be leaked let alone announced and conspiracy is therefore infeasible." Milgrom (1987, p. 27) succinctly states that "collusion is hardest to support when secret price concessions are possible, and easiest to support when all price offers must be made publicly."

Theoretically at least, the four formats can be ranked from most prone to collusion to least prone:

- (1) English auction;
- (2) Uniform second-price auction;
- (3) Discriminatory first-price auction;
- (4) Dutch auction.

The English auction is potentially the most susceptible to collusion because there is no incentive to betray the ring--more aggressive bidding does not win the item--and such attempts are highly visible to the other members of the ring. On the other hand, the Dutch, descending-price, auction is potentially the least susceptible to collusion because of the difficulties that ring members would have supporting and enforcing collusive behavior. Once a ring member bids more aggressively than was agreed, his or her actions are not only obvious but the auction is won before the others can react.

### III. APPLICATIONS

This section discusses three applications of the various mechanisms for auctioning different items, taking in turn the auction of government securities, refinance credit, and foreign exchange. At the outset of this section, it should be emphasized that there is no unambiguous answer to the question of which is the "best" auction technique to use. This conclusion reflects the difficulties of applying the theoretical literature to real world settings as well as the importance of individual country circumstances.

#### GOVERNMENT SECURITIES

There is considerable controversy over the types of auctions that are most suitable for selling government securities. As we have seen, the theoretical analysis deals with bidders who demand only one indivisible unit of the commodity being auctioned. However, frequently in the case of auctioning government securities, bidders may submit bids for multiple units of the security, and they may also be permitted to submit multiple bids--in effect, demanding differing quantities and prices at the same

.. auction. In such circumstances, theoretical models can offer only limited insight, and care must be taken in applying theoretical results to real world settings.

Consider first the U.S. government securities market. The weekly auction of treasury securities by the U.S. Government is structured differently from the simpler theoretical formats discussed earlier and offers an excellent example of the gap between stylized models and real world settings. In addition, this market has been subject to much recent analysis and proposed changes; accordingly, the details of the market are readily available. The U.S. Treasury's offering of some two and a half trillion dollars in new debt annually is auctioned in a multiple-price, sealed-bid auction with active, open trading both preceding and following each event. Thirteen-and 26-week maturities are auctioned weekly; longer maturities are offered several times a year. The Department of the Treasury publicly announces the amount of debt securities it is offering, which are traded in an active "when-issued" market. This market is essentially a forward market for the securities, in which the actual issue date is the delivery date for the forward contract. This "forward market" serves two important functions: allocative and evaluative. In the latter, it provides insight into the participant's common-value beliefs about the securities' marketability .

At present, there are 39 bidders--"primary dealers"--who can participate in the U.S. Treasury auction. They submit sealed bids specifying a price and the number of securities they are willing to purchase at that price. These are referred to as "competitive bids" and approved dealers can submit them in several price-quantity combinations. In addition, the proceedings are open to the general public and individual investors through the submission of "noncompetitive" bids that specify a quantity sought, up to a fairly conservative maximum, determined by the Treasury. The price paid by these noncompetitive bidders is a quantity weighted average of the winning competitive bids. To the highest competitive bidder, the Treasury awards the amount specified at the stated price; the next highest bidder is awarded the amount demanded at his or her stated price; and so on until the supply is allocated. Winning bidders thus pay their bid, and all of them may pay different prices. The securities are delivered within a few days and may be resold in active secondary markets. Recently, starting in September 1992, the Treasury began selling two-and five-year bonds using a uniform-price auction on an experimental basis.

In addition to the forward market, there is a "repurchase and reverse" market in treasury securities, in which short-term borrowing and lending are collateralized by these instruments. One can borrow funds overnight by selling securities with an agreement to repurchase them the next day at a predetermined price, with the difference between the buying and the selling price being the return earned.

The potential for profit in Treasury auctions lies at the intersection of the three trading forums--the auction itself, the forward market, and the repurchase and reverse market. Sealed bidding combined with multiple prices creates the potential for any determined bidder to corner the postauction market. Well-informed and deep-pocketed groups can, by submitting deliberately high-valued bids, receive the bulk of awarded securities. Unsuccessful bidders who have taken a position in the "when issued," or forward, market are caught in a "short squeeze," where they are forced either to pay heavily to close their positions or to purchase securities at a premium in the repurchase market to honor their commitments. Under current Treasury auction procedures, the winner's curse places a premium on information regarding competitive bids (an important outcome of the "when-issued" market), creating the basis for a bid that will corner the primary auction and squeeze the postauction market.

Having described how the market works, we look at the arguments in favor of switching to a uniform second-price auction. One main argument rests on the belief that it will probably increase the revenue to the Treasury because,

following the theoretical section, the new format would mute the "winner's curse," leading to more aggressive bidding. The magnitude of this increase may, however, be small in the United States.(26) In any case, it is not clear that revenue maximization is an appropriate goal for the U.S. Treasury. Economic efficiency seems to be more appropriate.

Another often cited advantage of uniform auctions is that they increase participation, and hence competition, since the winner's curse is muted. It can, however, be argued that the number of bidders ( $n$ ) participating in a Treasury auction is endogenously determined. The potential number of competitive bidders includes the primary dealers (39) and all depository institutions (a couple of thousands). There is nothing to prevent the  $(n + 1)$ th bidder from entering. Clearly, the intramarginal investor does not think it profitable to bid. It is possible that this is related to the costs of "certification" and of establishing "creditworthiness." These costs are unlikely to change if one changes auction formats. Hence, we would not expect any significant increase in the number of competitive bidders if the Treasury moved to a uniform-price auction.(27) The recent experiences in Mexico, when it moved to a uniform-price auction from a discriminatory auction, and in Italy, when it moved from a uniform to a discriminatory auction, bear this out. The number of primary dealers in either country has not changed significantly.

A third advantage of a uniform-price auction is that it reduces socially suboptimal information gathering. The incentive to collect information diminishes in a uniform auction. Since gathering this information only redistributes wealth among bidders, it adds nothing to society as a whole. This, we believe, is a strong argument in favor of a uniform auction: it promotes economic efficiency. A final consideration is that it may be easier to implement.

Hence, any policy recommendation must be country specific. If a fairly active (competitive) market exists, a uniform-price auction would seem appropriate, since collusion is minimized and there could be some gain to society from less information acquisition. Revenues to the government may also increase.(28)

If the market in a particular country is thin and subject to collusion, a discriminatory auction would seem more appropriate. The benefits would exceed the deadweight loss implied by excessive information gathering. In an immature market, information collecting encouraged by the discriminatory format may be useful in the initial stages of market development. Nevertheless, if concerns about collusion are minimal, a later shift to a uniform format would be desirable. Needless to say, we would recommend measures to increase participation to make the market more competitive and safeguard against monopoly positions. These measures might include lowering barriers to entry and increasing the number of participants.

In some situations, English auctions might also be chosen, particularly in situations where it is possible to run a centralized, open auction (as in a small country where all direct auction participants could meet in one location, as, for example, with the foreign exchange auction in Romania).(29) In such a situation, a Dutch auction may also constitute a feasible and desirable option.

#### REFINANCE CREDIT

Another situation in which auction techniques can be usefully applied is in the allocation of refinance credit. In general terms, refinance credit represents direct lending by a central bank, usually to the financial sector but sometimes directly to ultimate users. Lending to the financial sector can be for the specific purpose of implementing monetary policy--for example, by providing liquidity to commercial banks to meet specified monetary targets. It can also represent "targeted" lending--for example, in some developing countries to support investment and economic development in key sectors--in which the central bank provides funds to the financial

sector for on-lending to targeted activities. When collateral (such as government securities) is required to obtain refinance credit, such credit is more likely to be called a repurchase agreement.(30) In this case, instead of extending a simple credit, the transaction entails an agreement that the borrower sell to the central bank a given security and later buy it back at the maturity date specified in the repurchase agreement. Alternatively, "refinance" facilities are also referred to as "rediscount" facilities when lending takes place against securities.(31)

A main issue that arises with refinance credit is how to allocate it. One nonprice, less market-oriented approach has been to set the price of refinance credit at a given interest rate and provide the credit on a first-come, first-serve basis up to some quantity limit. Some countries allocate refinance credit entirely on an administrative basis, directing such credit and setting its price. Frequently, when such lending is at administered rates, a substantial subsidy is involved because the administered rate is low compared with market-based interest rates. Operationally, in these cases, commercial banks have recourse (sometimes automatically) to the refinance facility at the central bank at below market-related interest rates for loans to specified sectors. Direct controls are sometimes used, instead of the first-come, first-serve approach, to achieve the desired distribution of credit and deal with the excess demand that would arise. In any event, the types of transactions described above can create significant distortions in the financial system.

Auction techniques may be viewed as a mechanism to allocate refinance credit.(32) They have the advantage of tying the refinance rate to market conditions and of improving efficiency. A potential added benefit is that auctions may improve transparency while lessening discretion in the allocation of credit. Although a topic outside the realm of this paper, it should be noted that to the extent that refinance credit is directed toward development objectives—for example, by providing subsidized credit to key sectors of the economy—such policy actions might more appropriately be handled as a fiscal matter, with subsidies being budgeted directly instead of implemented through interest rate policy. Otherwise, the central bank may be carrying quasi-fiscal operations on its balance sheet, potentially generating central bank losses and complicating monetary policy, as well as disguising the underlying fiscal position. In any event, whether the lending takes place through the fiscal authority or the central bank, auction techniques would be useful.(33)

The discussion of auction techniques in the context of auctioning government securities is largely applicable to refinance credit. Thus, much of the analysis presented earlier on government securities is relevant here, although an important qualification deserves emphasis. Auctioning refinance credit may differ in that payment to the seller of the auctioned item may not be required upfront as is the case with government securities. Instead, payment is effectively made when the refinance credit matures, thus subjecting the seller to the risk of nonpayment in the interim. Collateral requirements would reduce this risk, as would an appropriate evaluation of the creditworthiness of the auction participants and associated certification. A concern is to avoid the problems of adverse selection: allocating credit by price alone may create a situation where borrowers with the poorest credit risk always place the highest bids. Such a situation might arise, for example, when demanders of refinance credit have strong incentives to seek credit at higher prices because they themselves hold "nonperforming" assets in their portfolios and are ready to go under.(34)

#### FOREIGN EXCHANGE

Countries adopting market-related arrangements for their exchange rate have been confronted with two basic choices: operating an interbank type of market within the private sector, which may, in addition to commercial banks, include other licensed foreign exchange dealers; or an auction

system, whereby foreign exchange is surrendered to the central bank for auction to the highest bidders.(35)

As noted earlier, under the auction system countries have used different techniques, which basically divide into discriminatory-pricing (including Dutch auctions) and uniform-pricing approaches. A possible difficulty with discriminatory pricing is that it may discourage potential participants from entering the market or impede more aggressive bidding because of the winner's curse.(36) Other difficulties, using this format, concern the appropriate exchange rate to be used for transactions outside the auction (such as for government transactions and customs purposes).(37) Uniform pricing would deal with some of these difficulties and more closely match how private foreign exchange markets work. In any event, based on country experience, the interbank approach has gained comparative favor because it involves less government control over the availability of foreign exchange to the private sector than is implied by auctions, which rely on the government specifying the quantity available, at times meeting its own needs first.

The double auction is less restrictive in terms of limiting the supply of foreign exchange, as it brings in the private sector on both the supply and demand sides. This technique is implicit in an interbank market when brokers match the supply and demand orders that they receive. A main difference is that rather than being a continuous market, as with an interbank market, a double auction is run at discrete points in time--like a fixing session. Such an approach may be appropriate when a country has insufficient institutional capacity or experience to operate an interbank market, but some of the flexibility of the interbank approach is desirable.

#### IV. SUMMARY AND CONCLUSIONS

Auctions play a useful role in price discovery and resource allocation and are routinely used in market economies. This paper has focused on three applications of auction techniques, namely, auctioning government securities, refinance credit, and foreign exchange. In assessing the pros and cons of different auction formats, our starting point was to survey the theoretical literature. We described how auctions offer the advantage of simplicity in determining market-based prices where markets may be thin or nonexistent and in allocating the auctioned items efficiently. The appropriate choice of an auction format is less clear-cut. This ambiguity stems from the difficulties of applying theoretical results to real world settings and from the importance of individual country circumstances. Based on our earlier discussion, we conclude that there are no unambiguous answers to the question of which is the "best" auction technique to use.

We attempt to provide broad guidelines to appropriate auction formats in different circumstances. Our survey indicates that uniform second-price auctions, because of their administrative simplicity, economic efficiency, and revenue-enhancing potential, are perhaps the most widely applicable format. The ascending-price, English auction may be preferred in auctioning government securities or refinance credit. However, unless individual country circumstances provide for a bidding forum conducive to the open-outcry format, this mechanism is technically infeasible. In addition, the English auction is, potentially, the most prone to collusive agreements and should be avoided if prevailing institutional arrangements are conducive to "side deals." (38) We emphasize that, independent of the chosen format, auctions should be conducted competitively, with stringent safeguards against monopoly positions.

Some of the arguments need to be qualified in the case of foreign exchange auctions, in part because auctions may not be desirable in the first place. In using any of the four basic formats, the government retains a great deal of discretion in determining the amount of foreign exchange to be auctioned. This discretion can be disadvantageous at a time when the thrust of the reform effort is to develop the private sector. Double auctions

offer a favorable alternative, as the government participates on the same basis as the private sector. Nevertheless, the end goal is to encourage foreign exchange trading among participants of double auctions, and other participants in the economy, not only at the time of the auction but on a more continual basis. Thus, while auctions, especially double auctions, may be a useful intermediate step, development of an interbank market should ultimately be pursued under a floating-rate system.

In closing, we emphasize that there is a wide range of potential applications for auctions, both in terms of the specific items to be auctioned and across country groupings. In this regard, auctions can have an important role to play in the emerging market economies of the former Soviet Union and elsewhere. At present and to varying degrees, the institutional structures in these countries may not be conducive to free-market economic arrangements, and the advantages accruing from the use of auction techniques could be productively exploited. Indeed, auctions can play a pivotal role in acclimating economic agents to decisionmaking in a world of market-determined, changing prices and in efficiently allocating resources in the absence of alternative market mechanisms. More generally, the usefulness of auction mechanisms as a way to guide price determination and resource allocation applies to developing as well as industrial countries. Among the potential applications of auction techniques--in addition to those already discussed--are the privatization of state assets and the auctioning of quotas or trade licenses.

As stressed earlier, the choice of an appropriate auction format depends crucially on the specific item being auctioned and on the institutional arrangements prevailing in the country choosing between different auction techniques.

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#### FOOTNOTES

1 Reviews of the literature on auctions in different contexts can be found elsewhere, and our paper builds on the insights of these authors. See Maskin (1992), McAfee and McMillan (1987), Milgrom (1987, 1989), Milgrom and Weber (1982), and Smith (1987). In relation to recent assessments of the U.S. government securities market, excellent reviews of selected aspects of auction techniques are contained in Bikhchandani and Huang (1992), Chari and Weber (1992), Reinhart (1992), and the Joint Report on the Government Securities Market (1992).

2 The former is called a discriminatory or multiple-price auction and the latter a uniform-price auction. Definitions of different auction formats are provided in the next section of this paper. For the industrial countries, a very useful summary of the auction techniques used to sell government debt is found in the Joint Report on the Government Securities Market (1992), pp. B-29-B-40.

3 See Umlauf (1991) and Hernandez (1993).

4 These examples for foreign exchange are from Quirk and others (1987). It is interesting to note that when the International Monetary Fund auctioned part of its gold stock in 1976-80, the auctions were divided between discriminatory first-price and uniform second-price formats.

5 The traditional Dutch auction follows a discriminatory, not a uniform, multiple-unit pricing procedure.

6 This is most easily illustrated by a simple example. Suppose (i) there are four sellers of foreign exchange who each offer to sell one unit at the respective prices of 100, 200, 300, and 400 units of domestic currency and (ii) there are four demanders of foreign exchange who each demand one unit at the respective prices of 400, 300, 250, and 50 units of domestic currency. In this example, supply and demand would match at three units of foreign exchange; the equilibrium price would be indeterminate in the sense of lying between 200 and 250.

7 In contrast to what we term the four basic auction types, the theoretical literature on double auctions is sparse and the strategy and payoffs associated with them are difficult to summarize, as is done for the others in Table 1. Because of these considerations, we exclude double auctions from the next section, which focuses on theory.

8 Although double auctions are excluded from this section, the interested reader can turn to Wilson (1979, 1986), Friedman (1984), and Easley and Ledyard (1982) for technical articles that demonstrate the problems of modeling strategic behavior in this framework. Double auctions are applicable, as we will see, to foreign exchange fixings. More broadly, however, the operations of such well established markets as those for equities, in which dealers and brokers match supply and demand in their books, can be viewed as examples of double auctions.

9 Risk neutrality is assumed in order to focus on profit-maximizing behavior. Many of the theoretical results do not hold when risk aversion is introduced.



10 Clearly, any auction needs to ensure the quality of the bidding participants (such as their credit risk) to avoid problems like adverse selection, whereby the riskiest bidders always bid the highest prices. The theoretical literature, by comparison, assumes auction participants are homogeneous.

11 In an English auction, as noted in Table 1, new information is obtained from the bidding process, which is not the case with a second-price auction.

12 Because it is advantageous to better anticipate the market consensus, market participants may be encouraged to devote resources to the competitive assessment of rival bids and information.

13 This section is partly based on Chari and Weber (1992).

14 The literature distinguishes between direct and indirect mechanisms. The direct revelation principle states roughly that corresponding to an equilibrium outcome of an indirect mechanism there is a direct mechanism that will generate the same outcome.

15 A detailed discussion of the optimal auction mechanism when the independent private-value assumption is relaxed is beyond the scope of this paper. For an expanded discussion, see Cremer and McLean (1985a, 1985b). They provide a method, based on an assumption of correlated values, that involves the use of a lottery plus participation in a subsequent second-price auction.

16 In a recent paper, Back and Zender (1992) prove formally that if the unit demand assumption is relaxed it is possible that discriminatory-price auctions can yield higher revenues than the uniform-price auction.

17 See, in particular, Milgrom and Weber (1982), who offer a formal proof for the superiority of second-price over first-price common-value auctions. Reinhart (1992) provides an excellent discussion of the issues involved in the context of the U.S. treasury bill market.

18 Gilley and Karels (1981), in a study of bidding in oil-rights auctions, find that the smaller the variance in the initial estimates of a tract's value, the higher the bids. With high investments at stake, oil firms evidently recognize and avoid the winner's curse.

19 As Milgrom points out, the linkage principle implies that sellers should use royalties when auctioning mineral or publication rights, thus linking the price paid to actual value, and, on average, increasing the seller's profit.

20 See Holmstrom and Myerson (1983) for a discussion of efficiency in games with incomplete information. They propose ex ante, interim, and ex post efficiencies.

21 See Smith (1987).

22 In both these formats, bidders bid their reservation price since, in both cases, this is the dominant strategy to pursue; thus, both formats are efficient.

23 See Milgrom (1987) for an illustrative example.

24 See, in particular, Section 4b of Maskin (1992).

25 This vulnerability reflects the fact that fraudulent activity by the auctioneer is easier to hide when bids are sealed than when they are open.

26 See Vogel (1993).

27 Bear in mind, however, that even if the number of bidders were not to increase, there may still be more aggressive bidding.

It should also be noted that discriminatory pricing provides real incentives, because of the winner's curse, to know the market consensus, and may therefore create a concentration of information among more experienced auction participants, with less specialized bidders deferring to those holding information. In such a situation, primary dealers have some information advantage reflecting the added information on the distribution of bids from their customers. When information becomes overly concentrated, there is the possibility of collusion and market manipulation. Uniform auctions would help mitigate this concern.

28 As noted earlier, such increases may be small in the case of the United States.

29 This alternative has been proposed recently by Reinhart (1992) for the U.S. government securities market. However, the approach is different from what is being discussed here because the institutional setting does not rely on the auction physically taking place at one location but rather in a computer-based setting. The development of such a computer-based setting may be many years off in the United States because of the current state of technology, and may therefore be impractical for less technologically advanced countries.

30 A similar transaction, but one that involves commercial bank lending to the central bank, and therefore a drain of liquidity, is a reverse repurchase agreement.

31 Some might say that "rediscount" is a misnomer in this case, as the term may refer only to buying a security and holding it until maturity.

32 The former Czechoslovakia, Indonesia, Romania, and Tunisia are examples of countries that use an auction approach.

33 The World Bank and the Inter-American Development Bank have begun to allow some of their on-lent funds to be auctioned. See, for example, Guasch and Glaessner (1992b) for the case of Chile.

34 Guasch and Glaessner (1992a) discuss institutional approaches to dealing with adverse selection.

35 Quirk and others (1967) reviews the experience with these two arrangements up to January 1987.

36 Some countries have argued that this result can be advantageous in deterring speculators or at least in ensuring that they pay the full price for their bids. See Quirk and others (1987, p. 12).

37 See Quirk and others (1987).

38 In recommending the English, ascending-price format for auctioning U.S. Treasury securities, Reinhart (1992) argues that collusion is not a problem.

Robert A. Feldman is Assistant to the Director of the IMF's Research Department and holds a Ph.D. in economics from the University of Wisconsin. Rajnish Mehra is Professor of Finance at the University of California at Santa Barbara and holds a Ph.D. in finance from the Graduate School of Industrial Administration, Carnegie-Mellon University. A first draft of this paper was completed while Professor Mehra was a visiting scholar in the Research Department.

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